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In a number of instances, contact beds have been badly located, the tendency being to locate the contact bed too near the tank and, as follows, too near the dwelling. This is evidently in order to save the expense of installing a line of tight pipe to convey the effluent to a more favorable place of deposit. Notwithstanding this, no complaints have reached this office in which the contact bed was the source of complaint.

ANOPHELES PUNCTIPENNIS.

A NOTE ON ITS ABILITY TO SERVE AS A HOST FOR PLASMODIUM FALCIPARUM.

By M. Bruin Mitzmain, Technical Assistant, United States Public Health Service.

The susceptibility of *Anopheles punctipennis* Say to infection with the parasites of subtertian malaria has heretofore not been established in studies in connection with malarial investigations by the United States Public Health Service. In a previous intensive study,[1] negative results were obtained, following attempts at transmission through repeated bitings of two human subjects by mosquitoes previously given multiple feedings of blood of gametocyte carrying patients; these experiments also included the dissection of 219 specimens, all of which were negative.

On account of the apparent ease with which *Anopheles punctipennis* could be infected with the parasites of tertian malaria, it might be inferred that this mosquito exhibited a specific predilection similar to that reported for *Anopheles quadrimaculatus* and *Anopheles crucians* by local investigators. In a further series of experiments recently conducted in New Orleans, *Anopheles punctipennis* has proved easily infectible with *Plasmodium falciparum* Welch. Of one series of 16 mosquitoes, given a single feeding, one became infected; in a second group of 36, given a variable number of feedings, 13 infections resulted; in the two groups, 27 per cent of infections were observed. Of 8 examples of *Anopheles quadrimaculatus* used as controls, 4 developed infections.

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[1] *Anopheles punctipennis* Say: Its relation to the transmission of malaria. Report of experimental data relative to subtertian malarial fever, by M. Bruin Mitzmain, United States Public Health Reports, Feb. 11, 1916.

The following table summarizes the positive findings, and gives the developmental period in each mosquito:

Date of dissection.	Developmental period—(days).	Stage of development.
Oct. 28, 1916	11	18 oocysts; size 20–22 μ finely pigmented.
Nov. 15, 1916	13	8 oocysts without protoplasmic differentiation; size approximately 25 μ 28 μ.
Nov. 18, 1916	15	Approximately 250 oocysts in all stages preceding the sporoblastic.
Nov. 19, 1916	17	8 oocysts, 2 of which still retaining pigment, remainder granular without sporoblasts.
Nov. 20, 1916	19	Approximately 200 oocysts in all stages up to sporoblastic.
Nov. 25, 1916	24	43 oocysts; size 25–40 μ, mostly with malarial pigment, a few with sporoblasts.
Dec. 3, 1916	31	About 120 oocysts, half of them retaining pigment, only 1 with sporoblasts.
Do.......	31	Approximately 250 oocysts, of which 50 were quite small (15–20 μ) with malarial pigment; remainder various sizes, but more matured. Few with sporoblasts.
Do.......	32	30 oocysts in various stages; few, however, with young sporoblasts.
Dec. 24, 1916	37	1 oocyst represented by shrunken capsule, without contents; oocyst apparently full sized and firmly attached to gut wall.
Dec. 25, 1916	53	5 oocysts—4 with contents expelled, 1 with sporoblast development barely commencing (only 4 segments discernible). Remainder of body of oocyst undifferentiated and granular. Size, 30 μ x 33 μ.
Dec. 26, 1916	47	3 oocysts with contents ruptured all torn from gut wall during dissection. No evidence of sporozoites in mounting liquid surrounding the gut wall or in the glands.
Dec. 29, 1916	57	2 ruptured shrunken oocyst membranes on posterior end of mid gut. No indications of sporoblasts or sporozoites.
Jan. 1, 1917	59	1 oocyst, 22–25 μ, containing granules only. And 4 ruptured oocyst capsules still attached to stomach wall. No sporozoites present.

One control specimen of *Anopheles quadrimaculatus* which proved infected was examined on the twelfth day after biting the blood donor. The gut wall was covered by at least 200 oocysts. These were not over 35 μ in size, the majority exhibiting malarial pigment and averaging 20–25 μ in size. No mature oocyst was seen, and the glands were devoid of sporozoites.

The second control *Anopheles quadrimaculatus* found infected was examined 40 days after biting the blood donor. On the gut wall of this specimen were seen 3 oocysts and 3 shrunken capsules devoid of sporozoites or other bodies. The oocysts measured 59 μ to 67 μ in size, with undifferentiated granules lacking evidence of sporoblast development. A prolonged search was made of the mounting fluid surrounding the gut wall, but sporozoites were not found. The six lobes of the salivary glands were likewise uninfected.

Another specimen of *Anopheles quadrimaculatus* was found infected on the fortieth day of development. Here were seen three empty oocyst capsules and three large oocysts, one of which measured 59 by 65 μ and the other two were as much as 67 μ in diameter. The development of these oocysts was apparently abortive, as sporoblasts were absent and sporozoites were not present on stomach wall or in the six gland lobes.

The fourth specimen of this species to be found infected was dissected 54 days after its initial blood meal. The only indication of its infection was the presence of two apparently full-sized oocyst envelopes devoid of contents except for a few sporoblastlike bodies in one of them. The glands were negative, except for a moderate invasion of sporozoites in the mid lobe of one gland.

Throughout this series no mature forms of oocysts or gland sporozoites were encountered, except in the one instance noted. This is ascribed to the relatively low temperature in which development took place rather than to other factors.

Discussion and summary.

The experimental determination of the rôle of *Anopheles punctipennis* as a potential host for the common forms of malaria has been established, as ascertained by King.[1] No additional findings have been developed whereby previously reported negative results with this anopheline and *Plasmodium falciparum* might be accounted for.

In the present series, 52 specimens of *Anopheles punctipennis* were fed upon the blood of cases of subtertian malaria, and 14 infections resulted. Of 8 specimens of *Anopheles quadrimaculatus*, used as controls under identical conditions, 4 became infected.

Anopheles punctipennis, while highly susceptible to infection with *Plasmodium vivax*, exhibits no especial predilection toward this species; but it has been shown to be a sufficiently receptive host of *Plasmodium falciparum* to be held of sanitary importance.

From the writings of Beyer and his coworkers,[2] Craig,[3] and others, it has been concluded that a specific relation exists between American anophelines and the several varieties of malaria. The transmission of tertian and quartan malaria has been held to be effected by *Anopheles quadrimaculatus*, while to *Anopheles crucians* has been ascribed the incidence of subtertian malaria. Craig concluded that: "The observations noted explain clearly why certain localities suffer more severely than others from certain types of malarial infections. Given a locality in which only *Anopheles crucians* occurred and we could have nothing but estivo-autumnal infections; but if *Anopheles quadrimaculatus* were the only *Anopheles* present, we might have either tertian or quartan infections, but no estivo-autumnal malaria."

The present status of the common American anophelines with reference to their susceptibility to infection with the several species of malarial parasites is as follows:

Anopheles quadrimaculatus may serve as a host for all three parasites of malaria.

Anopheles punctipennis and *Anopheles crucians* are susceptible to infection with *Plasmodium vivax* and *Plasmodium falciparum*.

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[1] King (1916): Experiments on the development of malaria parasites in three American species of anopheles. The Journal of Experimental Medicine, June, 1916, volume 23, No. 6, pp. 703–716.

[2] Beyer, Pothier, Couret, and Lemann (1902): Experimental investigations with malaria in connection with the mosquitoes of New Orleans. New Orleans Medical and Surgical Journal, vol. 50, No. 1, January, 1902.

[3] Craig (1914): The prophylaxis of malaria with special reference to the military service. War Department Bulletin No. 6, August, 1914, pp. 43–44.